

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

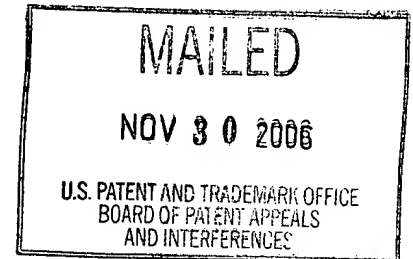
UNITED STATES PATENT AND TRADEMARK OFFICE

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Ex parte JOHANNES G.A. TERLINGEN
and GERADUS H.M. ENGBERS

Appeal No. 2006-2561
Application No. 09/762,779

ON BRIEF



Before SCHEINER, GRIMES, and LEOVITZ Administrative Patent Judges.

GRIMES, Administrative Patent Judge.

DECISION ON APPEAL

This appeal involves claims to an analytical device. The examiner has rejected the claims as anticipated by or obvious in view of the prior art. We have jurisdiction under 35 U.S.C. § 134. We affirm.

Background

"Interactions of specific compounds with solid surfaces play a crucial role in chemical and biological phenomena and areas including analysis techniques." Specification, page 1, lines 9-11. "To study real time surface interactions, several techniques are available, such as ellipsometry, reflectometry and surface plasmon resonance spectroscopy (SPR). These techniques have in common that they use the

reflectance of light, generated by a laser, to analyze the growth or disintegration of a layer of, for instance, biological molecules at a surface.” Id., lines 15-21 (as amended March 26, 2002).

“Methods for generating SPR sensor surfaces include arranging an organic surface onto a gold layer by means of a wet chemistry procedure.” Id., page 2, lines 5-7. “A further method includes adsorption of a chemical functional surfactant, by means of a wet chemistry procedure, on the surface to be modified and the subsequent immobilization of the surfactant by a plasma such as an argon plasma, so called plasma immobilization.” Id., page 2, lines 10-15.

The specification discloses “an improved device for investigating the reactions between interactive chemical species. . . . The device . . . provides good attachment of the plasma deposited layer, good stability thereof and a device exhibiting good sensitivity, whereby the substrate is provided with a function[al] layer, the functionality of which can be provided by . . . thiol groups, for example.” Id., page 2, lines 18-31 (as amended March 26, 2002).

“Since a functional group layer is plasma deposited, control over the deposition thereof can be accurately carried out, whereby very thin layers can be deposited thus providing very sensitive devices, without the need for firstly arranging an organic layer by wet chemical methods.” Id., page 2, line 36 to page 3, line 3.

“Plasma deposition procedures involve the deposition of organic species from the plasma phase on a substrate.” Id., page 3, lines 16-18. “The plasma deposited layer preferably comprises one or more sulphur compounds . . . since, especially when gold is chosen as the substrate, an improved stability is provided.” Id., page 4, lines 26-33.

Discussion

1. Claims

Claims 25 and 29-48 are pending and on appeal. Appellants did not argue the claims separately in the Appeal Brief, so the claims subject to each rejection will stand or fall together. See 37 CFR § 41.37(c)(1)(vii).

Claims 25, 31-33, 35, 36, 44, and 45 are representative and read as follows:

25. A device for investigating reactions between interactive chemical or biological species, said device comprising:

a substrate comprising a film of free electron metal consisting essentially of gold;
and

a plasma layer comprising sulfur plasma deposited directly on said gold film of said substrate and defining a stable deposited plasma layer.

31. The device according to claim 25, wherein the plasma layers comprise one or more compounds selected from the group consisting of sulfur-containing compounds, thiols, sulfides, disulfides and diallyl sulfide.

32. The device according to claim 31, wherein the substrate consists essentially of gold.

33. A process for producing a device for investigating reactions between interactive chemical and biological species, said process comprising the steps of (a) providing a pre-selected substrate, said substrate comprising a film of free electron metal consisting essentially of gold and (b) arranging a layer comprising sulfur plasma directly on the gold film by plasma deposition and defining a stable deposited plasma layer.

35. The process according to claim 33, wherein plasma is deposited from a monomer/oligomer/polymer in gas form, said monomer being saturated, partially saturated or unsaturated.

36. The process according to claim 33, wherein the substrate is subjected to a pre-cleaning step comprising pre-treating the substrate by means of a plasma etching step before the plasma deposition step.

44. A method for investigating the interaction, of pre-determined chemical or biological species, comprising the step of analyzing the interaction between chemical or biological species arranged on a device according to claim 25.

45. A method for investigating the reaction between chemically interactive species, comprising the step of exposing or depositing chemical or biological species on the device of claim 25.

Claim 25 is directed to a device comprising a film that consists essentially of gold and a "plasma layer comprising sulfur plasma deposited directly on said gold film." The latter limitation requires further interpretation.

As discussed above, the specification teaches that chemical compounds having functional groups such as thiol groups, can be "plasma deposited" onto a substrate. See the specification, page 2, lines 18-38. See also page 4, lines 26-33 ("The plasma deposited layer preferably comprises one or more sulphur compounds, for example thiols, sulfides and/or disulfides."). Thus, we interpret claim 25's reference to a "layer comprising sulfur" to mean a layer comprising a sulfur-containing compound, rather than a layer of elemental sulfur.

In addition, we interpret the phrase "sulfur plasma deposited" to mean a sulfur-containing compound, deposited on the substrate via plasma deposition. We have considered Appellants' argument that

the applicable claim language 'a plasma layer comprising sulfur plasma deposited directly on said gold film' means that the plasma is a sulfur plasma layer that has been deposited directly onto the gold film. Appellants never intended to use 'plasma deposited' as a discrete two-word phrase.

Reply Brief, page 1. Appellants' argument, essentially, is that the phrase "sulfur plasma deposited" means "sulfur plasma, deposited" in any way, as opposed to the examiner's interpretation of the phrase to mean "sulfur, plasma deposited."

We agree with the examiner's interpretation. The specification consistently uses the phrases "plasma deposited" and "plasma deposition" as discrete phrases. See, e.g., page 2, lines 25 and 36-37; page 3, line 16; page 4, lines 1 and 26; and page 15, line 10. Appellants have pointed to nothing in the specification that describes the claimed process as involving deposition by methods other than plasma deposition. For these reasons, we interpret the phrase "sulfur plasma deposited" to mean a layer of a sulfur-containing compound that has been plasma deposited on the gold film.

Finally, claim 25 refers to a "plasma layer" comprising a sulfur-containing compound. Appellants appear to argue that the claim requires the sulfur-containing compound to be in the form of a plasma, deposited on a gold film. See the Reply Brief, pages 1-2 ("[T]he invention . . . is nonetheless the presence of a sulfur plasma layer directly on the gold film. . . . [I]t is the adjacent combination of the sulfur plasma and gold film that, in context, is novel and inventive.").

We reject this interpretation of the claims. Appellants have provided the following background on plasmas:

"[P]lasma" has often been referred to as the fourth state of matter. The generation of plasma is analogous to the transition that occurs when energy is supplied to solid material, causing it to melt with the liquid's becoming a gas. When sufficient additional energy is supplied to a gas, plasma is created. A plasma describes a state of partially ionized gas which can, for example, be induced by applying an electric field to the gas under reduced pressure. The free electrons in the discharge are accelerated by the electric field and collide with neutral gas molecules. Due to these collisions, metastables, positive ions, electrons, free radicals and UV radiation are generated.

Appeal Brief, pages 8-9 (emphasis added). According to Appellants, a plasma is "a state of partially ionized gas" comprising "metastables, positive ions, electrons, [and]

free radicals.” Appellants have provided no evidence or scientific explanation of how a layer of a sulfur compound in the state of a partially ionized gas could be stably associated with a gold film.

Appellants’ argument is also contrary to the evidence of record. Dunn¹ teaches that plasma deposition results in the grafting of specific chemical functional groups onto a substrate surface:

A plasma of a suitable material may be used to modify the organic layer of organic and inorganic substrates, including polymeric materials, glass and metals. . . . The surface of the substrate is irreversibly modified by grafting specific chemical functional groups onto the surface with a plasma of a suitable material. . . . The surfaces which are modified . . . have specific chemical functional groups grafted onto the substrate surface and provide suitable surface chemistry for tissue culture growth.

Page 5. Thus, the evidence of record shows that plasma deposition techniques do not result in formation of a stable layer of a compound in the form of a plasma.

In summary, we interpret claim 25 to be directed to a device comprising a layer of a sulfur-containing compound, derived from a plasma and plasma deposited directly onto a gold film.

Claim 31 is directed to the same device, where the plasma deposited compound is a sulfur-containing compound, a thiol, a sulfide, or diallyl sulfide. Claim 32 depends on claim 31 and adds the limitation that “the substrate consists essentially of gold.”

Claims 35 and 36 are directed to methods for making a device such as that defined by claim 25 by plasma depositing a sulfur-containing compound onto a substrate that comprises a gold film. Claim 35 adds the limitation that the “plasma is deposited from a monomer/oligomer/polymer in gas form, said monomer being

¹ Dunn et al., European Patent Application EP104608, published April 4, 1984 (of record).

saturated, partially saturated or unsaturated.” Claim 36 adds the limitation that the substrate is cleaned by plasma etching before the plasma deposition step.

Claims 44 and 45 are directed to methods of using the device of claim 25. Claim 44 recites a method “comprising the step of analyzing the interaction between chemical or biological species arranged on a device according to claim 25.” Claim 45 recites a method comprising “exposing or depositing chemical or biological species on the device of claim 25.”

2. Definiteness

The examiner rejected claims 44 and 45 under 35 U.S.C. § 112, second paragraph, as indefinite. In both cases, the examiner objected that the claim language does not sufficiently define the steps of the claimed process. See the Examiner’s Answer, page 3 (“Claim 44 . . . does not set forth the steps involved in performing the analyzing.”) and page 4 (“Claim 45 is vague and indefinite because . . . no method steps have been provided for performing the process.”). The examiner also found the “chemical or biological species” recited in the claims to be confusing:

it is unclear if applicant is referring to the sulfur that has been deposited on the substrate or if applicant is referring to a sample containing a chemical or biological species which binds to the sulfur and is subsequently detected with another molecule or does the substrate comprise both a sulfur deposit and a chemical or biological species other than the sulfur . . . ?

Examiner’s Answer, pages 3-4.

Appellants argue that the techniques used for the “analyzing” step recited in claim 44 are well known in the art. Appeal Brief, page 7 (citing page 1, lines 9-21 of the specification). Appellants also argue that “exposing or depositing,” in claim 45, has its ordinary meaning and is therefore definite. Finally, Appellants argue that the claim

language, read in light of the specification, makes clear that the chemical or biological species are arranged on the sulfur plasma layer of the device of claim 25.

We agree with Appellants that claims 44 and 45 are not indefinite. Each of these claims is directed to a method of using the device of claim 25. In each case, therefore, the claimed method starts with a device having a layer of a plasma deposited, sulfur-containing compound on a substrate comprising a gold film.

The method defined by claim 45 requires taking that device and “exposing or depositing chemical or biological species on [it].” The method defined by claim 44 requires “analyzing the interaction between chemical or biological species arranged on” such a device. Since at least two species are required in order to have the interaction recited in claim 44, those of ordinary skill in the art would understand claim 44 to require the presence of at least one “chemical or biological species” in addition to the sulfur-containing compound deposited on the gold film.

Claims are in compliance with the second paragraph of 35 U.S.C. § 112 if, “read in light of the specification, [they] reasonably apprise those skilled in the art and are as precise as the subject matter permits.” Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1385, 231 USPQ 81, 94-95 (Fed. Cir. 1987). In our opinion, claims 44 and 45 meet that standard. The rejection under 35 U.S.C. § 112, second paragraph, is reversed.

3. Anticipation by Bergström

The examiner has rejected claims 25 and 29-31 as anticipated by Bergström.² The examiner notes that Bergström discloses a device comprising a gold film modified

² Bergström et al., WO 90/05303, published May 17, 1990.

with sulfur-containing compounds. Examiner's Answer, pages 4-5. The examiner acknowledges that the sulfur compounds in Bergström's device are not plasma deposited, but reasons that "[t]he claims are directed to a product and patentability does not depend on its method of production (plasma deposited). . . . Bergstrom et al[.] disclose the same device as recited in the instant claims[;] therefore, Bergstrom et al[.] anticipates the instantly recited claims." Id., page 5.

We agree with the examiner's position. Bergström discloses a biosensor device suitable for use in surface plasmon resonance (SPR) spectroscopy. See page 5, lines 1-27. The device comprises a "metal surface . . . constituted by a film of a free electron metal such as e.g. copper, silver, aluminum or gold. . . . [I]n view of corrosion stability considerations . . . gold should be the preferred metal." Id., lines 29-34.

The metal surface is modified with a "monolayer of an organic molecule X-R-Y." Id., lines 35-36. The X moiety in the X-R-Y molecule binds to the gold (page 6, line 12) and can be one of several sulfur-containing groups (page 6, lines 20-30). The R moiety is a hydrocarbon chain (page 6, lines 32-33) and the Y moiety is a functional group that binds the target substance (page 7, lines 1-6). In a working example, Bergström describes coating a gold-coated glass wafer with 16-mercaptohexadecanol. See page 15, lines 9-20.

We agree with the examiner that Bergström anticipates instant claim 1. Bergström discloses a device comprising a gold film having a layer of a sulfur-containing compound attached to it. Bergström does not disclose depositing a sulfur-containing compound using plasma deposition but "[t]he patentability of a product does not depend on its method of production. If the product in a product-by-process

claim is the same as . . . a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” In re Thorpe, 777 F.2d 695, 697, 227 USPQ 964, 966 (Fed. Cir. 1985). See also In re Pilkington, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969) (“[T]he patentability of a claim to a product does not rest merely on a difference in the method by which that product is made. Rather, it is the product itself which must be new and unobvious.”).

Appellants argue that

[w]hen a plasma is created from a hydrocarbon gas, the plasma polymers are no longer polymer analogues of the “monomer.” Under plasma conditions, the monomer molecules undergo fragmentation and deposit polymer molecules onto a solid surface. However, the plasma polymer does not contain regularly repeating units (e.g., the chains are branched and randomly terminated with a high degree of crosslinking). Because the plasma phase consists of a wide variety of very reactive species, the final composition of a surface after treatment with a plasma is essentially disordered and unpredictable and does not have the same chemical composition as the gas that was originally used. Therefore, the stable sulfur plasma layer of the present invention is a completely different layer having substantially different properties from the self-assembled monolayer disclosed in the Bergstrom patent.

Appeal Brief, page 9.

We find this argument unpersuasive. First, it is unclear what relevance Appellants’ discussion of polymers has to the device disclosed by Bergström; Bergström’s X-R-Y compounds are not polymers. In addition, Appellants have pointed to no evidence in the record supporting their argument that a device having a plasma deposited layer of an X-R-Y compound would differ structurally from Bergström’s device.

“Where a product-by-process claim is rejected over a prior art product that appears to be identical, although produced by a different process, the burden is upon the applicants to come forward with evidence establishing an unobvious difference

between the claimed product and the prior art product.” In re Marosi, 710 F.2d 799, 803, 218 USPQ 289, 292-93 (Fed. Cir. 1983) (emphasis added). “Attorney’s argument in a brief cannot take the place of evidence.” In re Pearson, 494 F.2d 1399, 1405, 181 USPQ 641, 646 (CCPA 1974).

The device disclosed by Bergström reasonably appears to meet the limitations of instant claim 1, and Appellants have cited no evidence to show that it does not. We therefore affirm the rejection of claim 25. Claims 29-31 fall with claim 25.

4. Obviousness in view of Dunn and Bergström

The examiner has rejected claims 25, 29-31, 33, 37-45, and 48 under 35 U.S.C. § 103 as obvious in view of the combined disclosures of Dunn and Bergström. The examiner reasons that Dunn teaches plasma deposition of compounds, including sulfur-containing compounds, on substrates that can be metal surfaces. See the Examiner’s Answer, pages 6-7.

The examiner acknowledges that Dunn does not expressly teach depositing compounds on a substrate that comprises a gold film, but relies on Bergström for that limitation. Id., page 7. He concludes that

[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the use of a gold film as taught by Bergstrom et al[.] into the method and apparatus of Dunn et al[.] because Bergstrom et al[.] teaches that gold provides for a more stable metal surface because of corrosion stability considerations.

Id., page 8.

We agree with the examiner that the cited references would have made the device of claim 25 prima facie obvious to those of ordinary skill in the art. Dunn teaches that a

plasma of a suitable material may be used to modify the surface layer of organic and inorganic substrates, including polymeric materials, glass and metals. . . . Suitable materials include, but are not limited to oxygen, carbon, hydrogen, nitrogen, halogen, sulfur, [and] phosphorus. . . . The surfaces which are modified . . . have specific chemical functional groups grafted onto the substrate surface and provide suitable surface chemistry for tissue culture growth.

Page 5 (emphasis added).

Dunn also teaches that the disclosed plasma deposition process can be used to modify the surfaces of “metals, such as iron, aluminum, tin, copper and nickel.” Page 8, lines 28-31. In a working example, Dunn describes coating a polystyrene strip with SO₂ via plasma deposition. See page 11, line 28 to page 12, line 3.

Bergström teaches a device comprising a “monolayer of an organic molecule X-R-Y [applied] to [a] metal surface.” Page 5, last paragraph. “The metal surface is constituted by a film of a free electron metal such as e.g. copper, silver, aluminum or gold. . . . [I]n view of corrosion stability considerations . . . gold should be the preferred metal.” Id. Bergström also teaches that “sulfur compounds . . . have a high affinity for noble metals.” Page 4, last paragraph. Finally, Bergström provides a working example in which 16-mercaptohexadecanol was applied to a gold-coated glass wafer. Page 15, lines 9-20.

We agree with the examiner that the device defined by instant claim 25 would have been obvious in view of Dunn and Bergström. Specifically, Dunn teaches coating the surfaces of metals with, among other things, sulfur-containing compounds. Dunn does not specifically disclose coating a substrate comprising a gold film, but Bergström teaches that sulfur compounds have a high affinity for noble metals and that gold has superior corrosion stability compared to other free electron metals. Thus, it would have

been obvious to a person of ordinary skill in the art to substitute a substrate containing a gold film for one of the other metals specified by Dunn. Motivation to do so is provided by Bergström, which teaches that sulfur compounds have a high affinity for noble metals and that gold has superior corrosion stability characteristics.

Appellants argue that “a fair reading of the Dunn patent in its entirety would not lead or motivate the skilled artisan to use gold, specifically, as a substrate for sulfur plasma deposit.” Appeal Brief, page 12. Appellants point out that Dunn’s working examples all use polystyrene substrates, not gold. Id. Appellants also argue that “gold is a rare, noble metal. . . . A noble metal is defined as any metal that has resistance to corrosion or oxidation and includes gold, silver and platinum. . . . However, the list of metals disclosed in the Dunn patent does not include any of gold or silver or platinum.” Id. Appellants conclude that “[w]hen considering the Dunn patent in its entirety, wherein all of the Examples use a polystyrene substrate and the list of metal substrates fails to disclose any of the noble metals, the Dunn patent directs away from the use of gold as a substrate for plasma deposition.” Id., page 13.

This argument is not persuasive. First, Appellants are incorrect in asserting that Dunn “fails to disclose any of the noble metals.” Dunn’s list of metal substrates includes copper, which is a noble metal like gold and silver. See Kirk-Othmer,³ page 381 (“Copper . . . is classed with silver and gold as a noble metal.”). We do not agree that Dunn’s listing of specific exemplary metals, including copper, would have directed away from other metals, including gold, that are not specifically listed.

³ Kirk-Othmer Encyclopedia of Chemical Technology, 4th edition, Vol. 7 (1993) (copy attached).

Appellants also argue that “the Bergstrom patent requires a particular orientation of the organic molecule X-R-Y to the metal surface. . . . Because of the nature of a plasma, the specific type of orientation required in the process of the Bergstrom patent could not be achieved using a plasma. . . . Therefore, absent hindsight, there is no teaching, suggestion or motivation in the Dunn patent or the Bergstrom patent, alone or in combination, to provide a device that includes a gold substrate with a sulfur plasma layer on its surface.” Id., page 13.

This argument is not persuasive. Appellants’ argument, in essence, is that a person of ordinary skill in the art would not have been motivated to modify Bergström’s method by substituting plasma deposition for the wet chemistry method used by Bergström. The examiner’s rejection is premised on combining the gold substrate taught by Bergström with the plasma deposition method taught by Dunn. Since the method posited by the examiner does not involve Bergström’s X-R-Y compounds, the effect of plasma deposition on those compounds is not germane to the issue on appeal – whether those skilled in the art would have found it obvious to practice Dunn’s method using a gold substrate.

Our conclusion is not affected by Appellants’ declaratory evidence. Appellants have submitted an affidavit by Gerardus Engbers (originally filed July 9, 2004) to support their position that “the specific orientation of the self-assembled monolayers (SAMs) could not be achieved by gas plasma deposition. Because a plasma as disclosed in the Dunn patent is not suitable to yield a surface with a high degree of order and functionality such as required by the Bergstrom patent, the Affidavit

substantiates that a skilled artisan would not have combined these two references together in the first place.” Id., pages 13-14.

The Engbers affidavit does not support Appellants’ assertions because it says nothing about the teachings of Bergström. The affidavit was apparently submitted to rebut a rejection based on Dunn and U.S. Patent 6,291,188 (Meade). Dr. Engbers declares that Meade’s sulfur-containing compound “is not volatile enough to be able to be deposited by plasma deposition.” Page 2, first paragraph. Dr. Engbers also declares that

Meade chooses SAM’s [self-assembled monomers] since Meade requires a specific orientation of the compound on the surface whereby one terminal is pointed to the gold surface and the other terminal is pointed to the environment.

This type of orientation is not achieved in the current process by gas plasma deposition.

During gas plasma deposition a certain fragmentation of the compound occurs. . . . Meade most certainly does not want fragmentation to occur since this would damage the composition of the sulphur containing compounds whereby the interactions with the surfaces would be negatively influenced.

Id., page 2, paragraphs 3-5.

Appellants have provided no comparison of the methods of Meade and Bergström. Thus, it is unclear how, if at all, Dr. Engbers’ assertions apply to the process disclosed by Bergström. The affidavit therefore does not support Appellants’ argument that those of skill in the art would not have combined Dunn and Bergström.

Finally, Appellants argue that “the claimed invention possesses unexpectedly improved surface properties that the prior art does not have.” Appeal Brief, page 14. Appellants point to Tables 1 and 4 of the instant specification and argue that the results

show that “the loss of mass in the surface composition of a plasma layer that does not include sulfur is thirty three (33) times greater than the loss of mass on the surface composition of the sulfur-containing plasma layer.” Id. Appellants assert that Dunn and Bergström do not suggest “the new and unexpected result of a stable sulfur plasma deposited layer of the claimed invention.” Id., page 15.

Appellants’ evidence does not overcome the prima facie case of obviousness. First, there is no objective evidence that the results shown in the specification are unexpected. The results are characterized as unexpected only in the Appeal Brief, and attorney argument is not evidence. In re Pearson, 494 F.2d 1399, 1405, 181 USPQ 641, 646 (CCPA 1974). In this case, the evidence of record would seem to support an expectation that sulfur-containing compounds bind strongly to a gold substrate. See, e.g., Bergström, page 4, last paragraph (“[S]ulfur compounds . . . have a high affinity for noble metals.”).

In addition, “when unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected compared with the closest prior art.” In re Baxter-Travenol Labs., 952 F.2d 388, 392, 21 USPQ2d 1281, 1285 (Fed. Cir. 1991). Here, the closest prior art would appear to be either the wet chemistry deposit of sulfur-containing compounds on a gold substrate (as taught by Bergström) or plasma deposition of a sulfur-containing compound on a non-gold metal substrate (as taught by Dunn). Appellants’ comparison of a sulfur-containing compound and a non-sulfur-containing compound, both plasma deposited on a gold substrate, does not represent a comparison of the claimed invention with the closest prior art.

5. Obviousness in view of Dunn, Bergström, and Tarlov⁴

The examiner rejected claims 32, 34, 46, and 47 under 35 U.S.C. § 103 as obvious in view of the combined disclosures of Dunn, Bergström, and Tarlov.⁵ Claim 32 is representative of the rejected claims and is directed to the device of claim 25, where “the substrate consists essentially of gold” and the plasma deposited compound is a sulfur-containing compound, a thiol, a sulfide, or diallyl sulfide.

The examiner relied on Tarlov for the suggestion to use a substrate that consists essentially of gold in Dunn’s plasma deposition method. In our opinion, this limitation is suggested by Bergström, which teaches that gold is the preferred substrate for attaching sulfur compounds because of its corrosion stability and because sulfur compounds bind strongly to noble metals. Therefore, it would have been obvious to use a substrate that consists essentially of gold in Dunn’s method.

The rejection of claims 32, 34, 46, and 47 as obvious in view of Dunn, Bergström, and Tarlov is affirmed.

6. Obviousness in view of Dunn, Bergström, and Kolluri

The examiner rejected claim 35 under 35 U.S.C. § 103 as obvious in view of the combined disclosures of Dunn, Bergström, and Kolluri.⁶ Claim 35 is directed to a method for making a device such as that of claim 25 by plasma depositing a sulfur-containing compound onto a substrate that comprises a gold film, where “plasma is

⁴ Appellants did not separately argue the rejections of claims 32, 34-36, 46, and 47. Appeal Brief, pages 15-16. Nonetheless, we must still consider whether the examiner has made out a *prima facie* case of obviousness with respect to at least one claim subject to each rejection. See *In re McDaniel*, 293 F.3d 1379, 1384, 63 USPQ2d 1462, 1465-66 (Fed. Cir. 2002).

⁵ Tarlov et al., U.S. Patent 5,942,397, issued August 24, 1999.

⁶ Kolluri et al., U.S. Patent 5,723,219, issued March 3, 1998.

deposited from a monomer/oligomer/polymer in gas form, said monomer being saturated, partially saturated or unsaturated.”

The examiner relied on Kolluri for the suggestion to use a monomer in gas form in Dunn’s plasma deposition method. In our opinion, this limitation is reasonably suggested by Dunn itself. Dunn provides a working example in which SO₂, a monomer, is plasma deposited onto a polystyrene substrate. See pages 11-12. Plasmas by definition are generated from compositions that are in the form of a gas. See the Appeal Brief, paragraph bridging pages 8 and 9 (“When sufficient additional energy is supplied to a gas, plasma is created. A plasma describes a state of partially ionized gas.”). Thus, Dunn would have suggested, to those of skill in the art, depositing a sulfur-containing compound from a monomer in gas form.

The rejection of claim 35 as obvious in view of Dunn, Bergström, and Kolluri is affirmed.

7. Obviousness in view of Dunn, Bergström, and Sluka

The examiner rejected claim 36 under 35 U.S.C. § 103 as obvious in view of the combined disclosures of Dunn, Bergström, and Sluka.⁷ Claim 36 is directed to a method for making a device such as that of claim 25 by cleaning a substrate comprising a gold film by plasma etching, then plasma depositing a sulfur-containing compound onto the substrate. The examiner reasoned that “Sluka et al[.] teach the step of cleaning the substrate by means of a pulsed argon plasma before the application of the functional groups to the substrate (col 3, lines 21-24).” Examiner’s Answer, page 10.

⁷ Sluka et al., U.S. Patent 5,932,296, issued August 3, 1999.

Sluka teaches that

[t]he polymerizable amine can be applied to the surface by means of the pulsed plasma in a single operating step. However it is preferred to firstly clean the substrates by means of a pulsed argon plasma and subsequently to apply the polymerizable amine to the surface in two steps.

Column 3, lines 21-25.

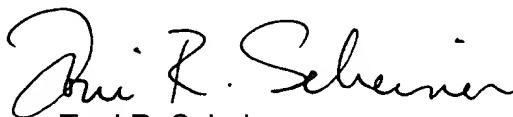
We agree with the examiner that the cited references support a prima facie case of obviousness. Specifically, it would have been obvious to modify the process suggested by Dunn and Bergström by adding an initial step of cleaning the substrate by plasma etching, because Sluka teaches that a two-step process – first plasma cleaning, then plasma deposition – is preferred. The rejection of claim 36 as obvious in view of Dunn, Bergström, and Sluka is affirmed.

Summary

We reverse the rejection of claims 44 and 45 for indefiniteness. We affirm the rejection of claims 25 and 29-31 for anticipation and the rejection of claims 25 and 29-48 for obviousness.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED



Toni R. Scheiner
Administrative Patent Judge



Eric Grimes
Administrative Patent Judge



Richard M. Lebovitz
Administrative Patent Judge

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COPPER

Copper [7440-50-8], Cu, critically important to the development of civilization, is the only common metal found naturally in the metallic state. It was thus suitable for the production of tools, and ancient people made use of its easy workability and beauty. Furthermore, the ease with which the oxide can be reduced to the metal, together with the tendency of copper to alloy with other metals naturally present in the ores, promoted broad usage.

Copper, the first element of Group 11 (IB) of the Periodic Table, is immediately above silver and gold. It is classed with silver and gold as a noble metal and can be found in nature in the elemental form. Copper occurs as two natural isotopes, ^{63}Cu and ^{65}Cu (1).

The high electrical and thermal conductivities and corrosion resistance of copper combined with its workability give the metal its very wide range of commercial applications. Unlike most metals, which are alloyed with other elements to enhance properties, for example, alloy steel and aluminum, copper is primarily used in its pure, unalloyed form.

The earliest recorded use of copper was in northern Iraq about 8500 BC and then in Asia Minor and Egypt around 7000 BC. Copper items found on the Sinai Peninsula have been dated at about 3800 BC (2). The world's oldest known copper smelting furnace, dating to 3500 BC, is located near the Timna copper mine in Israel. Deposits on Cyprus were mined as early as 3000 BC. During this early period the Egyptians developed the metallurgical arts and the use of bronze became relatively common. The mines on Cyprus were prized possessions of the empires that followed the Egyptians and became the chief source of metal for the Roman Empire. The metal was named *aes syprium* and subsequently *cuprum*, from which is derived the English word *copper* and the symbol Cu.

Developments in the metallurgy of copper or its alloys were mentioned in 1556 in *De Re Metallica*, where the process of copper ore was described by Agricola (see also COPPER ALLOYS). About that time, smelting operations commenced at Mansfield, Germany, and at the Swansea smelter in Wales. Both smelters

employed successive oxidations and reductions to eliminate iron and sulfur. The process used in the Swansea smelter is similar to modern techniques.

Between 1869 and 1877 the Calumet and Hecla Company in Michigan became the largest individual copper producer in the world; its annual copper production was less than 6200 t. By 1877, the mines of Rio Tinto in the Huelva province of southern Spain took a leading position, with an annual output of slightly more than 24,000 t. In the 1890s the Anaconda Copper Company, Montana, surpassed this mark with an annual output of 34,000 t. The Anaconda mine maintained its position as the world's largest copper mine until 1920, increasing annual output to more than 50,000 t.

Large-scale mining of low grade ores is a development of the twentieth century. The potential of massive low grade porphyry deposits was first realized when concentration methods were developed at the open-pit mine at Bingham Canyon, Utah (3). Introduction of froth flotation (qv) for beneficiation of sulfide ores during the 1920s improved metal recovery and gave impetus to the exploitation of the low grade porphyry deposits in Arizona, which became the leading copper producing area in the United States.

The exploitation of large ore bodies in Chile and Peru has made South America the world's largest producer of copper. The United States is the second largest, followed by Zaire and Zambia, and the CIS. Other important deposits are found in southern Oceania (Papua New Guinea, the Philippines, and Indonesia), Canada, Mexico, and Poland.

Occurrence

Cosmically, copper is relatively abundant: 100–400 ppm are found in the metal phase of meteoric iron (see EXTRATERRESTRIAL MATERIALS). The high affinity of copper for sulfur is the principal factor in determining the manner of occurrence in the earth's crust. Copper–iron sulfides are the last minerals to crystallize, and these fill the interstices between other minerals in igneous rocks, which contain an average of about 60–70 ppm copper (4). Other copper compounds occurring in nature are oxides and silicates. The strong affinity of copper for sulfur is the prime factor in separating copper from iron in the pyrometallurgical reduction of copper from sulfide ore.

Copper ore minerals may be classified as primary, secondary, oxidized, and native copper. Primary minerals were concentrated in ore bodies by hydrothermal processes; secondary minerals formed when copper sulfide deposits exposed at the surface were leached by weathering and groundwater, and the copper reprecipitated near the water table (see METALLURGY, EXTRACTIVE). The important copper minerals are listed in Table 1. Of the sulfide ores, bornite, chalcopyrite, and tetrahedrite–tennantite are primary minerals and covellite, chalcocite, and digenite are more commonly secondary minerals. The oxide minerals, such as chrysocolla, malachite, and azurite, were formed by oxidation of surface sulfides. Native copper is usually found in the oxidized zone. However, the principal native copper deposits in Michigan are considered primary (5).

Most copper deposits are (1) porphyry deposits and vein replacement deposits, (2) strata-bound deposits in sedimentary rocks, (3) massive sulfide deposits in